REMARKS

I. Introduction

By the present Amendment, claim 1 has been amended. Claim 18 is newly presented for consideration. Accordingly, claims 1-10 and 18 are now pending in the application. Claims 1 and 18 are independent.

II. Office Action Summary

In the Office Action of June 16, 2009, claims 1-17 were subject to a Restriction Requirement. Claim 1 was objected to because of an informality. Claims 1-10 were rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 5,910,118 issued to Kanda et al. ("Kanda") in view of U.S. Patent No. 4,671,293 issued to Shaulov, and further in view of U.S. Patent No. 4,932,414 issued to Coleman et al. ("Coleman"). These rejections are respectfully traversed.

III. Restriction Requirement

Claims 1-17 were subject to a Restriction Requirement as being directed to three different inventions. The Office Action further indicated that two of the inventions were sub-combinations, and requested election of one of the two combinations. During a telephone conversation with Applicants' representative on May 20, 2009, a provisional election was made, without traverse, to prosecute the invention of combination group 2, encompassing claims 1-10.

In accordance with the Examiner's request, Applicants affirm election of the combination of groups 1 and 2, which encompasses claims 1-10.

IV. Objections to the Claims

Claim 1 was objected to because of an informality. Regarding this objection, the Office Action indicates that the preamble recites "A ultrasonic" with should have been amended to --An ultrasonic--.

By the present Amendment, Applicants have amended independent claim 1, as suggested in the Office Action, to correct the grammatical error.

The Office Action further indicates that line 12 of claim 1 contained a comma which should be replaced by a semicolon.

Applicants respectfully disagree and request withdrawal of this objection. At the outset, it is noted that such punctuations are not proper grounds for raising an objection to the claims. Furthermore, Applicants note that the punctuation throughout the claim is, in fact, proper. Specifically, the elements of the claim are separated by semicolons, while the two wherein clauses are separated from each other and the elements by commas. This is actually the proper way to isolate sections of a claim that are structured such as those recited in independent claim 1. In any event, Applicants note that the choice of punctuation between a comma and a semicolon is well within Applicants' choice, so long as the claim itself remains grammatically correct.

Withdrawal of these objections is therefore respectfully requested.

V. Rejections under 35 USC §103

Claims 1-10 were rejected under 35 USC §103(a) as being unpatentable over Kanda in view of Shaulov, and further in view of Coleman. Regarding this rejection, the Office Action alleges that Kanda discloses a diagnostic ultrasound apparatus that includes an ultrasound probe bilaterally signal-changing between an ultrasound

signal and an electric signal and transmitting system circuits and receiving/processing system circuits, while using a Doppler detector to measure the velocity, blood flow, and motion that is pertinent to the claimed invention. The Office Action further indicates that the ultrasonic probe comprises an array of piezoelectric transducer elements arranged in an array and in a scanning direction, in that an ultrasound pulse is radiated from each transducer in response to the driving pulses being supplied. The ultrasound pulses are indicated as traveling into an object with a transmitting beam formed according to controlled transmission delay times, and partially reflected at boundaries with acoustic impedance changes in order to provide echoes. The Office Action further indicates that the reflected echoes are received by the transducers and converted into corresponding electric signals. The Office Action goes on to indicate that Kanda discloses extraction of echo signals to undergo estimation of motion of blood flow and two-dimensional tomographic images are produced based on the estimated information. Furthermore, Kanda is alleged as disclosing a moving target indication (MTI) filter which extracts blood flow and reconstructs a CFM image to become three-dimensional volume data.

The Office Action admits that Kanda fails to disclose a first and second transducer and a first cross section image being obtained by the transducer and a second cross-section image by a second transducer. Kanda is relied upon for disclosing an array of transducers that comprises a plurality of piezoelectric elements to transmit waves onto the regions and acquire or produce two-dimensional cross-section images. Coleman is relied upon for disclosing the use of ultrasonics to provide real-time, cross-sectional and 3D images of an organ. Shaulov is relied upon for disclosing a biplane phased array ultrasonic transducer arrangement which permits real time imaging of two planar sectors that can be at any relative angle to

another. The Office Action concludes that it would have been obvious to combine the teachings of Kanda, Coleman and Shaulov in order to arrive at the claimed invention. Applicants respectfully disagree.

As amended, independent claim 1 defines an ultrasonic motion detecting device that comprises:

> first and second ultrasonic transducers having piezoelectric elements arranged in an array, which transmit ultrasonic waves to an object and acquire reflection signals from the object;
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> a motion detection unit that extracts an estimation region which is used for estimating a motion of the object from the reflection signals that are acquired by the first and second ultrasonic transducers, and detects a three-dimensional motion of the object within the estimation region; and
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> an image display unit that displays the three-dimensional motion within the estimation region,
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> wherein ultrasonic wave scanning surfaces due to the first and second ultrasonic transducers cross over each other, and
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> wherein the motion detection unit detects projected components that are detected from a plurality of first two-dimensional cross-section images of the object which are obtained from the first ultrasonic transducer and a plurality of second two-dimensional cross-section images of the object which are obtained from the second ultrasonic transducer to produce velocity components of the three-dimensional motion, and constructs the three-dimensional motion on the basis of the first two-dimensional cross-section image, the second two-dimensional cross-section image and the projected components.

The ultrasonic motion detecting device of independent claim 1 includes first and second ultrasonic transducers having piezoelectric elements arranged in an array in order to transmit ultrasonic waves to an object and acquire reflection signals from the object. A motion detector unit extracts and estimation region that is used for estimating the motion of the object from the reflection signals acquired by the first and second ultrasonic transducers, and detecting a three-dimensional motion of the object within the estimation region. An image display unit is provided for displaying

the three-dimensional motion within the estimation region. According to independent claim 1, the ultrasonic wave scanning surfaces due to the first and second ultrasonic transducers cross over each other. Furthermore, the motion detection unit detects projected components that are detected from a plurality of first dimensional cross-section images of the object obtained from the first ultrasonic transducer and a plurality of second two-dimensional cross-section images of the object obtained from the second ultrasonic transducer. The motion detection unit then produces velocity components of the three-dimensional motion and constructs the three-dimensional motion based on the first two-dimensional cross-section image, the second two-dimensional cross-section image, and the projected components.

According to the present invention, the motion estimation of the object is conducted on the intersection planes of the two scanning surfaces, and the velocity components of the three-dimensional motion of the objects are detected. The two-dimensional information of the intersection planes are used to obtain the velocity components of the three-dimensional motion of the object without noise or the influence of minute fluctuations of signal. See paragraph [0065] of the published application.

Kanda discloses an ultrasound imaging apparatus wherein a Doppler signal is detected from a group of echo signals consisting of a train of sequential Doppler data for each spatial sample position in each scanning direction. The amount of instantaneous changes in the phase of clutter components in the Doppler signal is estimated as representative of the clutter component occurring due to reflection of the ultrasound signal from an organ.

According to Kanda, the MTI filter is used to assist in distinguishing echoes reflected from blood flows of extremely low velocities from clutter components in a

steady and accurate manner. Kanda explicitly indicates that the clutter components are caused by organs in motion. This is done in order to produce two-dimensional-mapped blood flow images. Thus, by distinguishing and separating these clutter components, Kanda actively removes the organs in order to only display the blood flow images. See column 2, lines 53-64. Kanda clearly treats echoes reflected from organs as noise and eliminates them. It is therefore not possible to detect object (organ/body) motion because echoes reflected from the organs are discarded.

Furthermore, as illustrated in Fig. 3, Kanda's apparatus utilizes two-dimensional information for each pixel. This is readily apparent because the number of pixels represents one dimension of the three-dimensional space. In particular, Kanda indicates that the first direction (L) represents the number of scanning lines, the second direction (M) represents the number of pixels, and the third direction (N) represents the number of data at each pixel. The Doppler data is then aligned in a time sequential manner in order to provide information corresponding to the dynamics of blood flow for each pixel. See column 6, lines 56-65. Kanda appears to be completely silent on detecting the velocity components of three-dimensional motion of an object, such as an organ, particularly based on the use of multiple two-dimensional cross-section images.

Coleman discloses a system for obtaining cross-sectional and 3-dimensional images of a body using ultrasonic energy. A piezoelectric transducer is positioned to emit ultrasonic energy and receive echo pulses. The transducer is swept or rotated to produce a series of sectored scan planes separated by a known angular distance, and the resulting echo pulses are processed to produce an ultrasonic image in pseudo 3-dimensional display. Data from one scan plane is processed as a B-scan image in order to obtain cross-sectional data. Coleman only appears to disclose

detection of a focal point with the diagnostic transducer. See col. 6, lines 49-59 and col. 8, lines 46-51. Coleman appears to completely silent on detecting velocity components of the three-dimensional motion of the object. Applicant's review of Shaulov has also failed to reveal any disclosure or suggestion for such features. In particularly, the art of record fails to provide any disclosure or suggestion for features recited in independent claim 1, such as:

> wherein the motion detection unit detects projected components that are detected from a plurality of first two-dimensional cross-section images of the object which are obtained from the first ultrasonic transducer and a plurality of second two-dimensional cross-section images of the object which are obtained from the second ultrasonic transducer to produce velocity components of the three-dimensional motion, and constructs the three-dimensional motion on the basis of the first two-dimensional cross-section image, the second two-dimensional cross-section image and the projected components.

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claims 2-6 and 8-10 depend from independent claim 1, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim 1. In addition, these claims each introduce novel elements that independently render them patentable over the art of record.

Independent claim 18 is newly presented and defines an ultrasonic motion detecting device that comprises:

> first and second ultrasonic transducers, which transmit ultrasonic waves to an object and acquire reflection signals from the object; and
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> a motion detection unit that extracts an estimation region which is used for estimating a motion of the object from the reflection signals that are acquired by the first and second ultrasonic transducers, and detects a three-dimensional motion of the object within the estimation region;

wherein ultrasonic wave scanning surfaces due to the first and second ultrasonic transducers cross over each other, and

wherein the motion detection unit detects velocity components of the three-dimensional cross-section image of the object obtained from the first ultrasonic transducer and a second two-dimensional cross-section image of the object obtained from the second ultrasonic transducer, and constructs the three-dimensional motion of the object to be displayed in an image display unit in accordance with the velocity components of the three-dimensional motion of the object.

According to at least one feature of independent claim 18, the motion detection unit detects velocity components of the three-dimensional cross-section image of the object obtained from the first ultrasonic transducer and a second two-dimensional cross-section image of the object obtained from the second ultrasonic transducer. The motion detection unit then constructs the three-dimensional motion of the object to be displayed in an image display unit in accordance with the velocity components of the three-dimensional motion of the object. As previously discussed, the art of record fails to provide any disclosure or suggestion for detecting velocity components of the three-dimensional motion of the object.

It is therefore respectfully submitted that independent claim 18 is allowable over the art of record.

VI. Conclusion

For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, the issuance of a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 520.46263X00).

Respectfully submitted,
ANTONELLI, TERRY, STOUT & KRAUS, LLP.

/Leonid D. Thenor/
Leonid D. Thenor
Registration No. 39,397

LDT/vvr
1300 N. Seventeenth Street
Suite 1800
Arlington, Virginia 22209
Tel: 703-312-6600
Fax: 703-312-6666

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